1962

Investigation of Surficants on Gamma and Speed

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by

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Submitted in Partial Fulfillment
of the Requirments for the Degree
Bachelor of Science

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ABSTRACT

The effects of Photoflo and Tween-20, two surficants were investigated on three different films. Gamma and speed were the criteria investigated. Photoflo was found to have generally little or no effect on the criteria investigated. Tween-20 was found to be effective in increasing the gamma and speed of the films tested. The relationship of gamma and speed change versus concentration level did not follow any recognizable pattern.

INTRODUCTION

The addition of a surficant to a photographic developer was employed to investigate the effect it imparts to gamma and speed.

Surficants are commonly used by the photographer as an implement to insure rapid and uniform drying. The mechanism perhaps being the increase in the rate of diffusion of water out of the emulsion, initiated by the surficant. If the mechanism takes place as mentioned, perhaps it can also work in reverse by increasing the rate of diffusion of developer into the emulsion.

EXPERIMENTAL PROCEDURE AND RESULTS

Two surficants and three types of film were employed. The films were representative of three emulsion speeds, Afga IF-17, Kodak Plus-X and Kodak Tri-X. A fast working developer, D-72 was used for all three films. For all of the tests a constant developer volume of 300ml was used and to this was added the proper surficant concentration. Five concentrations were used ranging

from 1 to 10ml. Measurement was made using a burret for the surficants and a volumetric flask for the developer.

The two surficants used were Kodak Photoflo and Atlas Chemical Industries' Tween-20. The Photoflo was used in its prepared form and the Tween-20 was diluted to a 10% working solution.

Processing was done in a tray with the film taped down and the ASA agitation system employed. A stop-bath was used to insure rapid cessation of development. Fixing was done according to practice.

Before any of the surficant tests were run control runs were made with the three films to standardize processing, exposure and gamma.

EXPERIMENTAL RESULTS

Photoflo

The general shape of the characteristic curves gives an indication of what is taking place. Figures 1, 2 and 3, illustrate the effect of Photoflo on the characteristic curves of the three films. It is clearly evident that Photoflo does not alter the shapes of the curves to any marked degree. In the case of IF-17 and Plus-X the six curves practically superimpose. The case for Tri-X is slightly different as the speed does increase at the 7ml concentration level by 27%. At this level too, the gamma has its highest value which is a 10% increase over the control level. Figures 7, 8, 9 and

10; illustrate how the gamma and speed values vary according to concentration.

Tween-20

When Tween-20 is used the results are quite different. The characteristic curves are changed to a high degree.

The gamma of IF-17 is still practically the same when compared with the Photoflo and the control run. However the film speed is increased by 90% (almost two times) at concentration levels of 7 and 10ml respectively. See Figures 4, 7 and 9.

For Plus-X the speed is only slightly affected by the Tween-20. The reagent increases the gamma to a marked degree. The gamma of Plus-X increases with the concentration, reaching its maximum value at the 10ml concentration level. This represents a 16% increase over the control run. See Figures 5, 7 and 9.

For Tri-X both the gamma and the speed change. The change in gamma being 28% at the 7ml concentration and the change in speed being 42% at the 4ml concentration level. See Figures 6, 8 and 10.

DISCUSSION

A statistical experiment was designed and computed using two response variables, gamma and speed. The results of the statistics did not show any factor significant at the .05 alpha level except for films. This was expected as the films were selected to be three different types.

By examining the graphs a number of generalizations can be made. Figures 1, 2 and 3, indicate the performance of Photoflo when it is added to the developer. IF-17 and Plus-X are not changed to any marked degree in the gamma and speed criteria. Figures 7 and 10 illustrate the plot of gamma versus concentration. It can readily be seen that the Photoflo values remain near the control level. Figure 3, the characteristic curves for Tri-X are slightly displaced indicating a speed shift. At the 7ml concentration level the graph (Figure 10) shows a large displacement at this point. The change is 25%. This is the largest percent increase in either gamma or speed for the three films with the Photoflo surficant.

From the data accumulated with the Photoflo area of the experiment it may be concluded that Photoflo is not an effective developer additive as used in the experiment.

The addition of Tween-20 to the developer indicated more favorable results. Figures 4, 5 and 6; clearly indicate what has taken place to the characteristic curves. IF-17 reacts quite favorably to treatment. While the gamma remains essentially as the control level, the speed increases by as much as 90% at concentrations of 7 and 10ml. Photographically this is almost one f/stop.

With Plus-X the speed is not affected to any great degree (Figure 9), but the gamma is (Figure 7). The gamma increases directly as concentration increases reaching .30 above the control run at the 10ml concentration level. This represents

a 16% change.

Tween-20 affects both the gamma and the speed of Tri-X (Figures 6, 8 and 10). Gamma increased by 28% at the 7ml concentration level and speed by 42% at the 4ml level. Contrasting Figure 8 to Figure 10, it can be seen that the speed is at the maximum value when the gamma is at its minimum value and vice-versa too.

When both surficants are examined (Figures 7, 8, 9, and 10), it can be seen that the variation of gamma and speed do not follow any set variation. Whether this is a random variation pattern or a fixed pattern cannot be determined on the basis of this experiment with any degree of accuracy. A larger sample will have to be taken or in other words replication of the experiment at least once. If the variation is not random, it indicates that discrete concentration levels are of importance. This can be illustrated by examining Figure 10.

From the data derived from the experiment it can be stated that Tween-20 can:

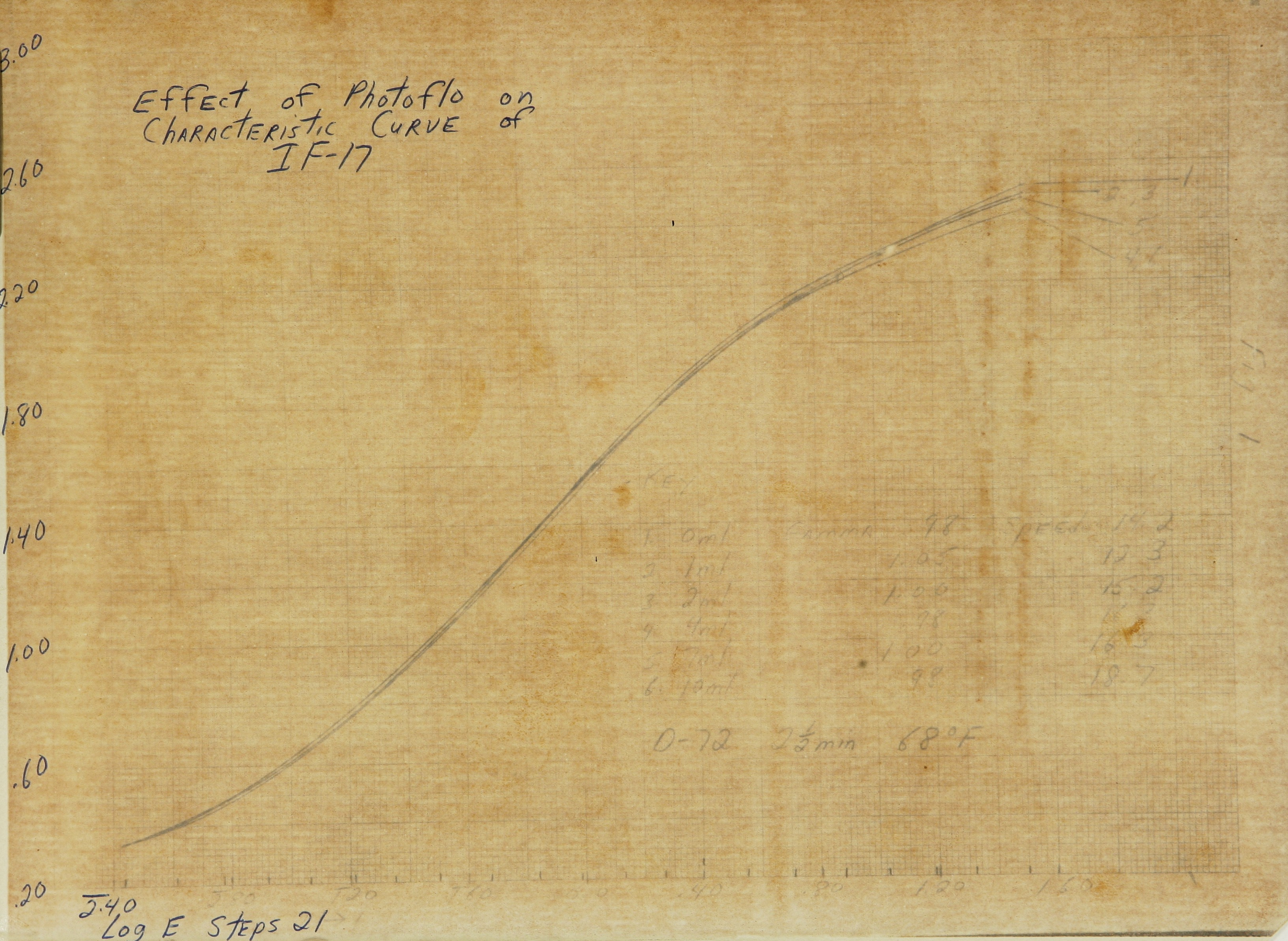
1. Reduce the time of development for a given gamma.
2. Increase the effective speed of a film.

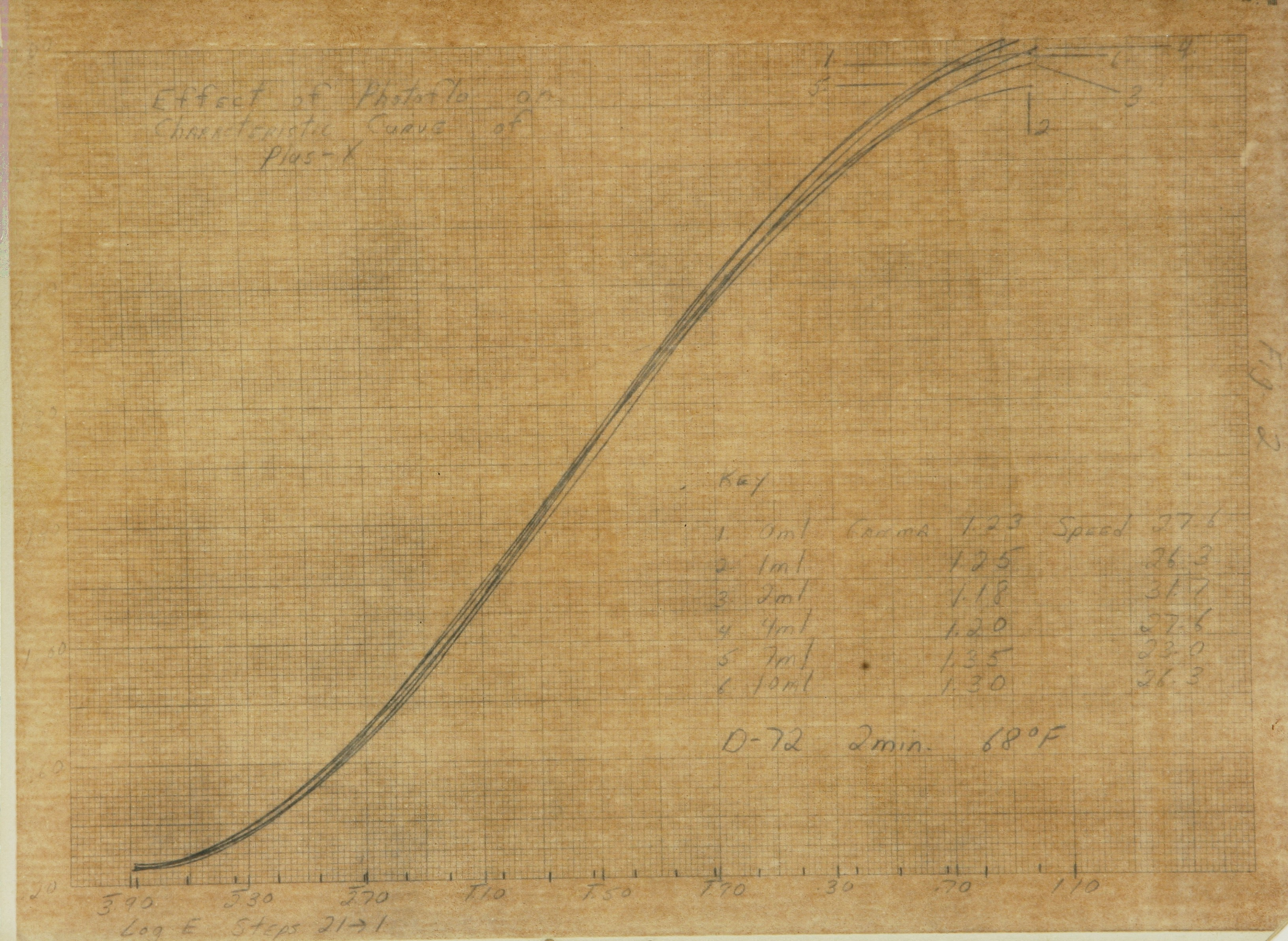
Future experimentation with surficants might best concern itself with the Tween-20 surficant. Photoflo does not warrant any further investigation. Higher concentrations and replication should be primary considerations in future investigations. The replication would determine whether the variation pattern of gamma and speed versus concentration is a random variation

or that the variation is actually part of the process.

ACKNOWLEDGMENTS

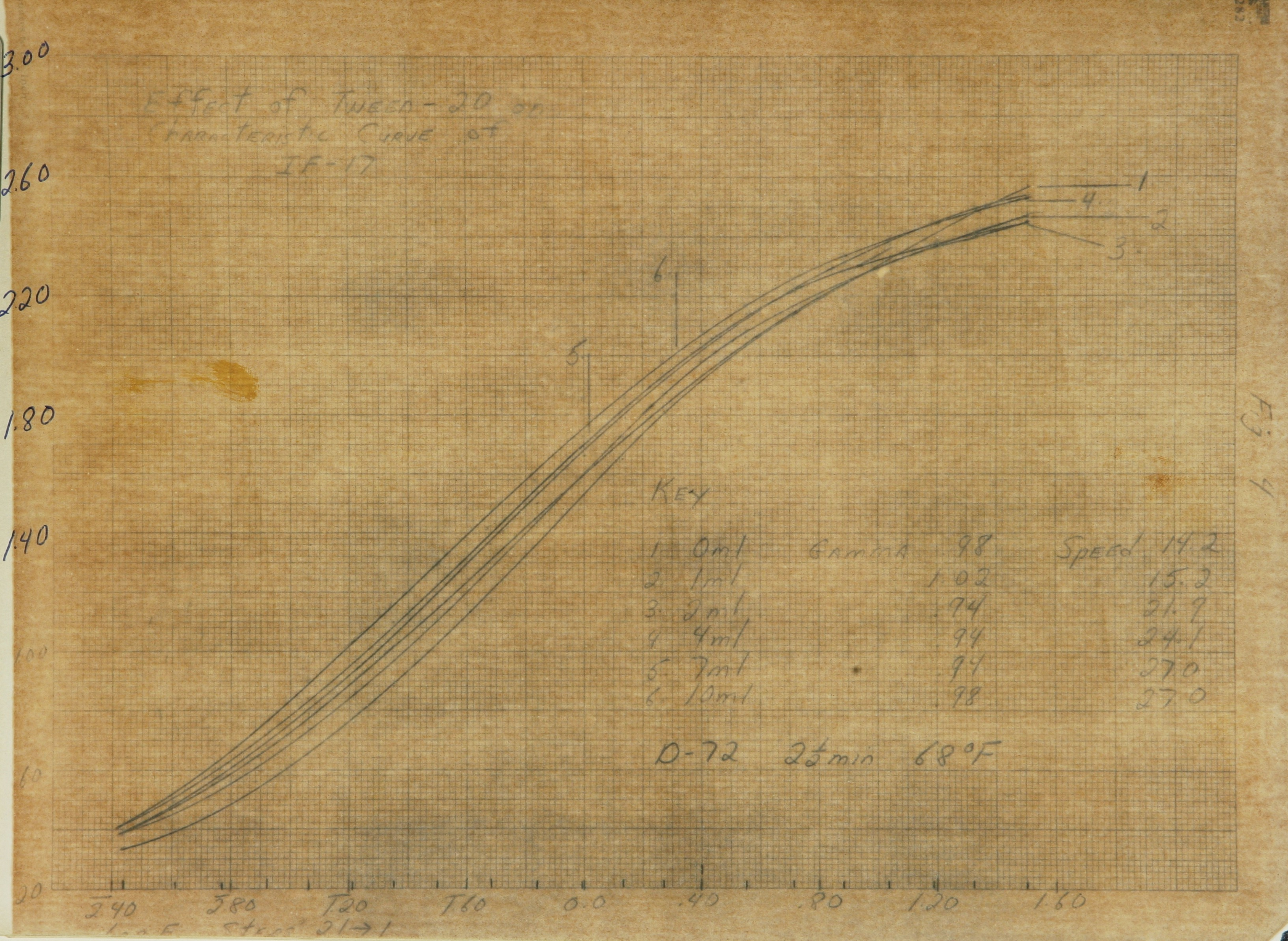
Acknowledgment is made of the assistance rendered in this work by Mr. A. Rickmers, Mr. W. Shoemaker and Mr. H. Todd.

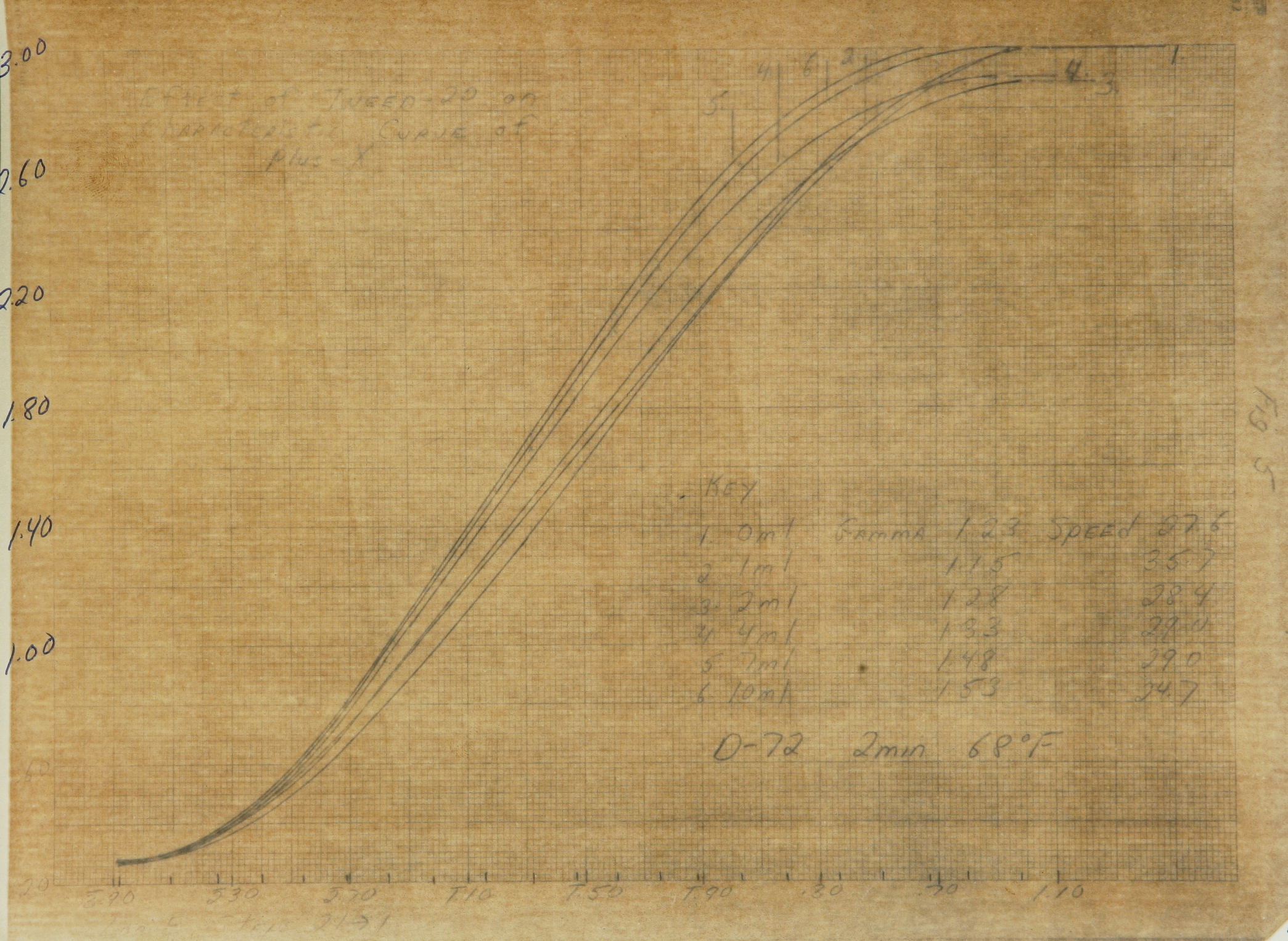

Effect of Photoflo on Characteristic Curve of IF-17
3.00
2.60
2.20
1.80
1.40
1.00
.60
.20
2.40
Log E Steps 21
D-72 2½ min 68°F


Effect of Photoflo on Characteristic Curve of Plus-X
1
2
3
4
Key
1. 0ml Coom A 1.23 Speed 27.6
2. 1ml 1.25 26.3
3. 2ml 1.18 31.7
4. 4ml 1.20 27.6
5. 7ml 1.35 22.0
6. 10ml 1.30 26.3
D-72 2min. 68°F
.90
.30
.70
1.10
1.50
2.0
-.90
-.30
-.70
-.10
.50
.90
.30
.70
1.10
Log E Steps 21→1


Effect of Photoflo on Characteristic Curve of Ilf. - X
3.00
2.60
2.20
1.80
1.40
1.00
.60
.20
4.5
1
2
3
6
Key
1. 0ml Gamma 1.00 Speed 107.1
2. 1ml 1.08 100.7
3. 2ml 1.00 118.1
4. 4ml 1.08 96.2
5. 7ml .75 135.6
6. 10ml 1.10 98.2
D-72 2min 68°F
360
500
540
580
720
760
00
40
80
Log E Steps .21 → 1

Fig. 3


Effect of Tween-20 on Characteristic Curve of IF-17
3.00
2.60
2.20
1.80
1.40
1.00
.60
.20
-.40
-.80
-.20
.0.0
.40
.80
1.20
1.60
1
4
2
3
6
5
Key
1 0ml Gamma .98 Speed 14.2
2 1ml 1.02 15.2
3 2ml .94 21.9
4 4ml .94 24.1
5 7ml .94 27.0
6 10ml .98 27.0
D-72 2½min 68°F


3.00
2.60
2.20
1.80
1.40
1.00
Effect of Fuser-20 on
Characteristic Curve of
plus-X
KEY
1. 0ml
2. 1ml
3. 2ml
4. 4ml
5. 7ml
6. 10ml
Gamma 1.23 Speed 277
1.15 357
1.28 284
1.33 271
1.48 290
1.53 247
D-72 2min 68°F
.90
.30
.50
.70
.10
.30
.50
.90
.30
.50
1.10


3.00
2.60
2.20
1.80
1.40
1.00
.60
.20
-2
-1
-3
-4
KEY
1. 0 ml Gamma 1.000 Speed 100.1
2. 1 ml 1.000 115.1
3. 2ml 1.10 126.3
4. 4ml 0.90 151.8
5. 7ml 1.28 93.5
6. 10ml 1.13 123.8
0-72 2min. 68°F
1.80 E Stops 21→1

Fig 7

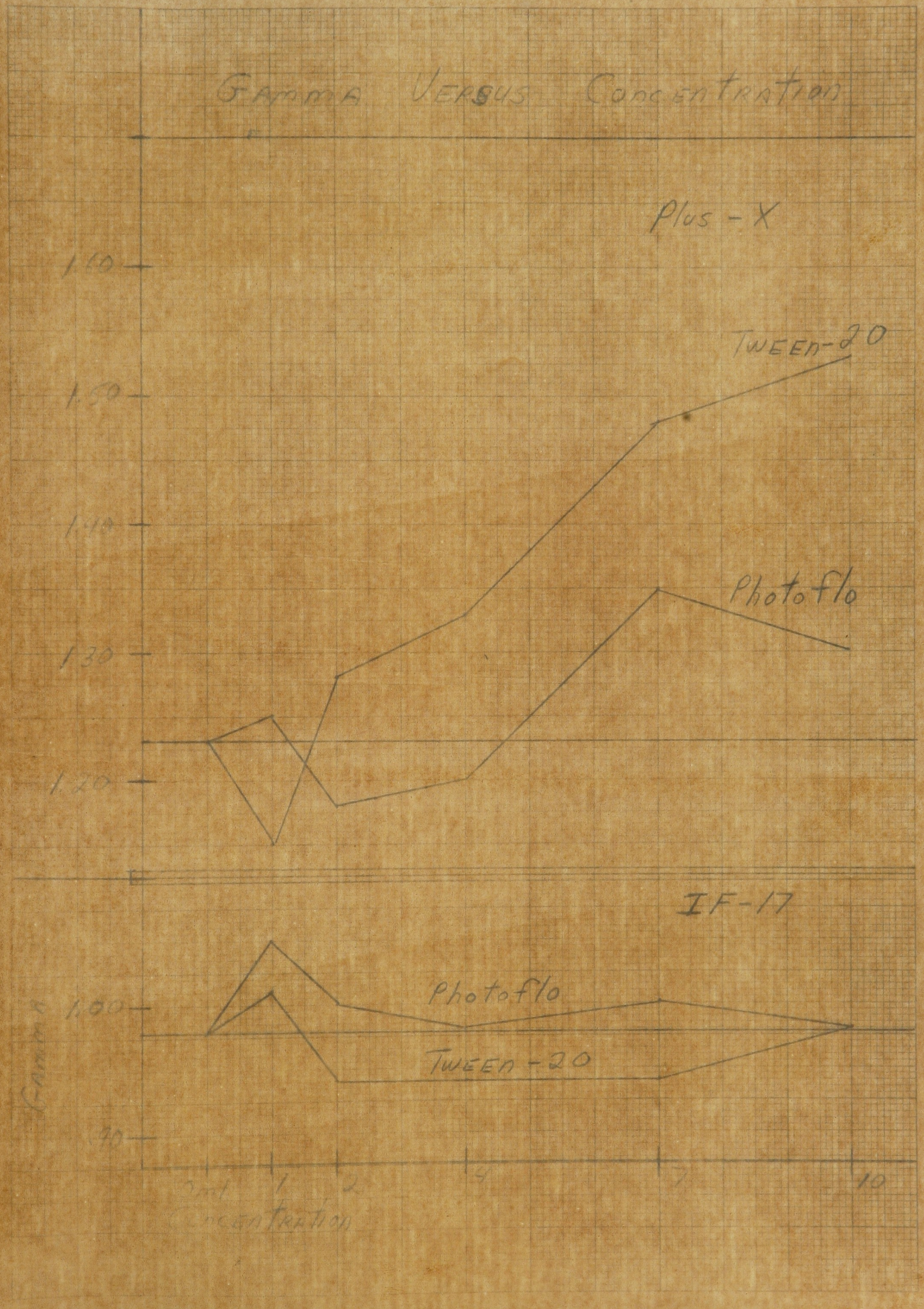

Gamma Versus Concentration
Plus - X
1.60
1.50
1.40
1.30
1.20
Tween-20
Photoflo
IF-17
1.00
.90
Photoflo
Tween-20
Gamma
1
2
4
7
10
Concentration

Fig 8

Gamma Versus Concentration

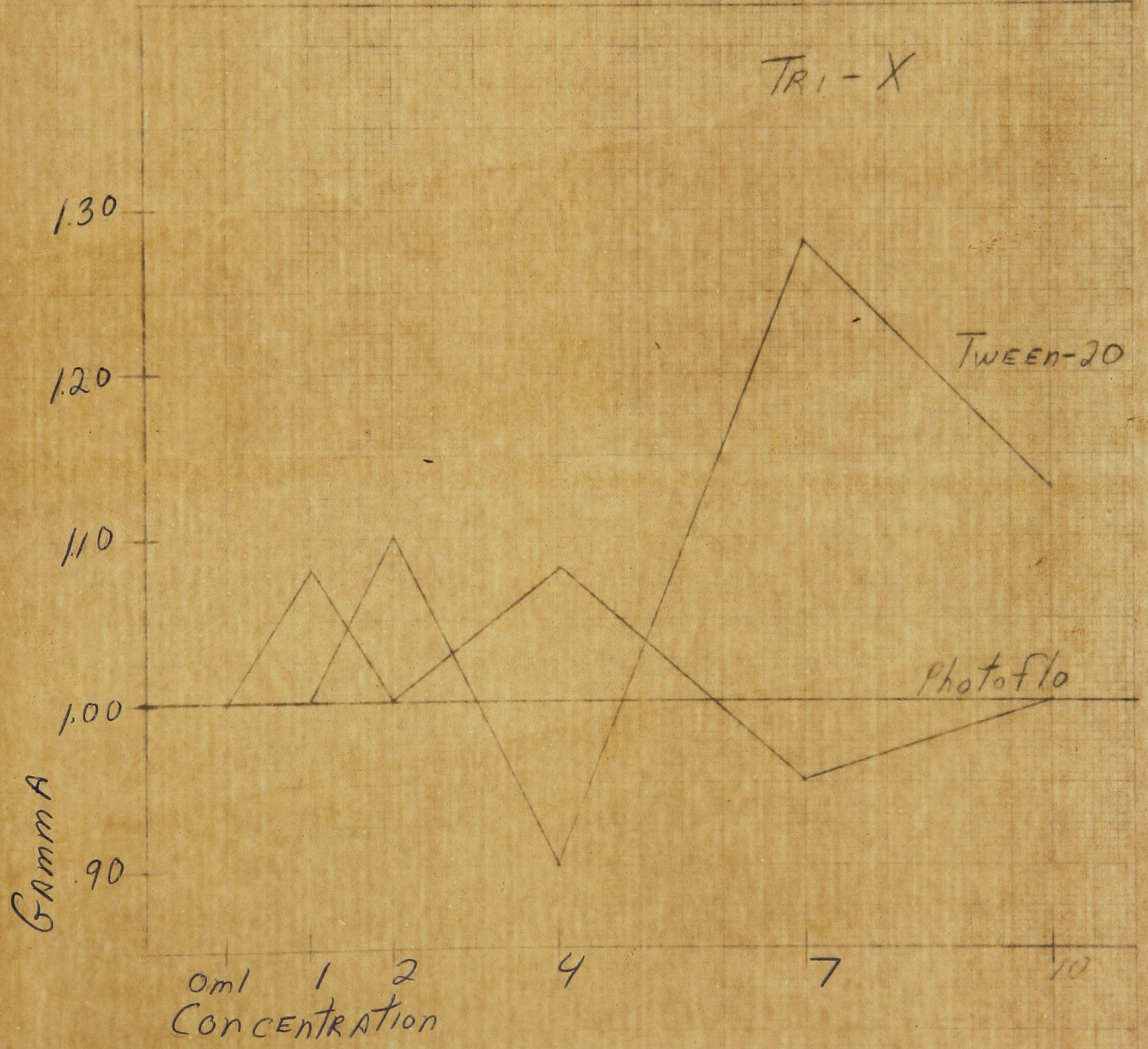


Fig 9

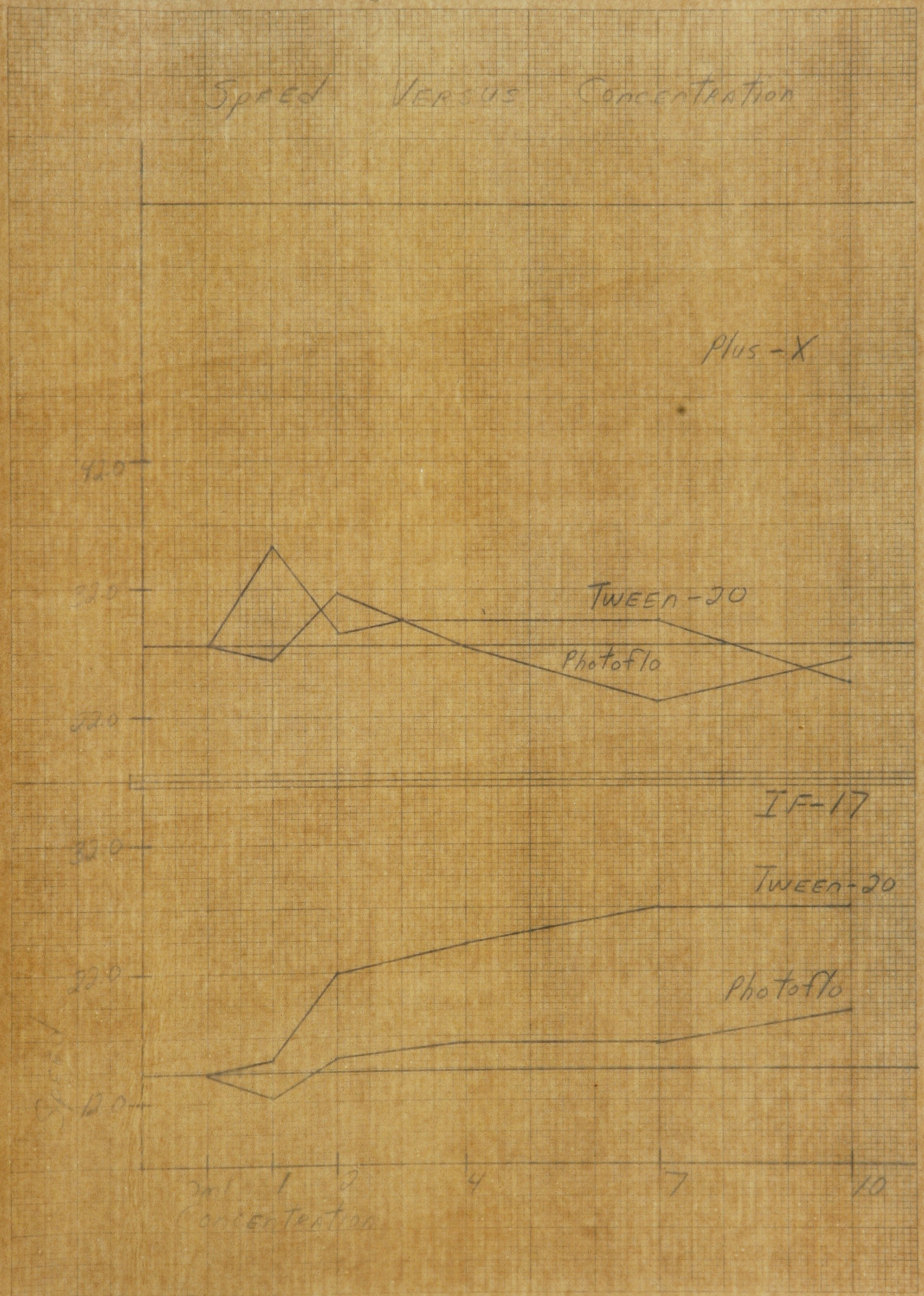

Speed Versus Concentration
Plus-X
Tween-20
Photoflo
IF-17
Tween-20
Photoflo
1
3
4
7
10

Fig. 10

Speed Versus Concentration